ARM Climate Research Facility

Southern Great Plains Newsletter

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Global Warming and Methane

Global warming, an increase in Earth's near-surface temperature, is believed to result from the buildup of what scientists refer to as "greenhouse gases." These gases include water vapor, carbon dioxide, methane, nitrous oxide, ozone, perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride. Greenhouse gases can absorb outgoing infrared (heat) radiation and re-emit it back to Earth, warming the surface. Thus, these gases act like the glass of a greenhouse enclosure, trapping infrared radiation inside and warming the space.

One of the more important greenhouse gases is the naturally occurring hydrocarbon methane. Methane (CH_4), a primary component of natural gas, is the second most important contributor to the greenhouse effect (after carbon dioxide). Natural sources of methane include wetlands, fossil sources, termites, oceans, freshwaters, and non-wetland soils. Methane is also produced by human-related (or anthropogenic) activities such as fossil fuel production, coal mining, rice cultivation, biomass burning, water treatment, waste management and landfill practices, and domesticated livestock operations. These anthropogenic activities account for approximately 60% of global methane emissions to the atmosphere (Figure 1).

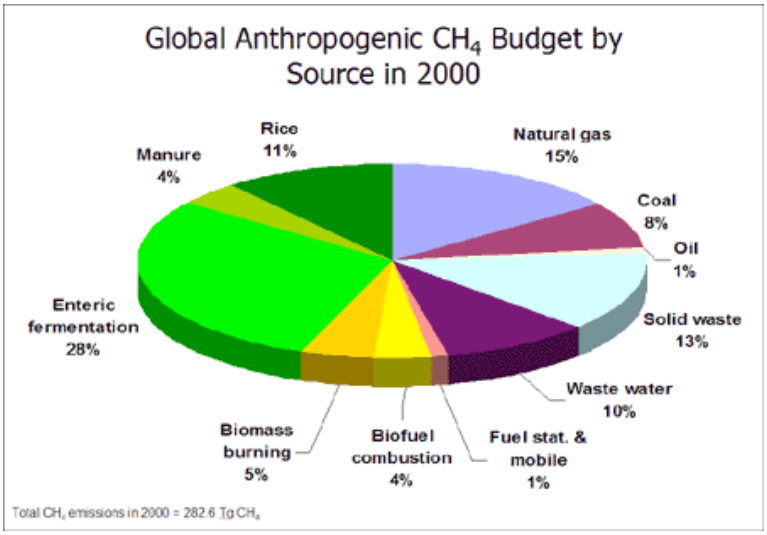

Figure 1. Global breakdown of anthropogenic methane emissions in 2000. (Source: EPA.)

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Technical Contact: Brad W. Orr
Phone: 630-252-8665
Email: brad.orr@anl.gov
Editor: Donna J. Holdridge
Website: http://www.arm.gov

Methane is removed naturally from the atmosphere in three ways. These removal methods, commonly referred to as sinks, are oxidation by chemical reaction with tropospheric hydroxyl ion, oxidation within the stratosphere, and microbial uptake by soils. In spite of their important role in removing excess methane from the atmosphere, the sinks cannot keep up with global methane production. Methane concentrations in the atmosphere have more than doubled since the beginning of the industrial revolution. Increases in atmospheric methane roughly parallel world population growth, pointing to anthropogenic sources as the cause. Increases in the methane concentration reduce Earth's natural cooling efficiency by trapping more of the outgoing terrestrial infrared radiation, increasing the near-surface temperature.

Two factors make methane a good target for efforts to counteract the greenhouse effect. The first factor is methane's ability to trap and re-emit infrared radiation. Methane is more than 20 times as effective as carbon dioxide at trapping heat in the atmosphere, making methane a more harmful and potent greenhouse gas constituent. The second factor is methane's chemical lifetime in the atmosphere — a relatively short 12 years, compared to the 120-year life span of carbon dioxide. This means that decreasing methane production will have greater and more immediate benefits than decreasing carbon dioxide production.

Over the past decade, the rate at which methane concentrations are increasing has slowed somewhat, in response to worldwide efforts to reduce methane emissions. In the United States, methane emissions decreased by 10% between 1990 and 2003, even though the total greenhouse gas emissions increased by 13% during the same period. Internationally, five nations are responsible for almost half of the anthropogenic methane emissions: China, Russia, India, the United States, and Brazil (in that order). In the United States, the U.S. Environmental Protection Agency (EPA) sponsors voluntary programs, providing technical support to help industries and others reduce methane production. The voluntary programs focus on reducing methane emissions associated with coal mining activities, oil and natural gas production, and landfills. In addition, the U.S. Department of Agriculture (USDA) and the EPA have two joint programs aimed at methane reduction on farms.

The first USDA-EPA program, the Ruminant Livestock Efficiency Program, is designed to help livestock producers make their operations more efficient with respect to production versus methane output. The EPA reports that one cow produces 75-265 pounds of methane each year. With the U.S. cattle population estimated at 100 million head, the amount of methane emitted reaches nearly 6 million tons annually. This is a significant amount, representing about 19% of total U.S. methane emissions (Figure 2). The total methane emission by all ruminant animals worldwide is about 80 million tons, or 28% of global methane emissions. Scientists have been investigating means of reducing methane

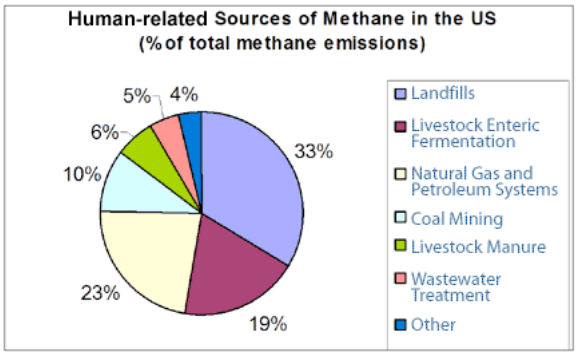

Figure 2. Contribution of the major anthropogenic sources to methane emission in the United States in 2001. (Source: EPA.)

emissions in the digestive process that is unique to the ruminant animals. This process is called enteric fermentation, and methane is a by-product. The most promising method for improving production while reducing methane emissions is a more nutritious diet, achieved with improved grazing and dietary supplements. Increased milk production per animal can allow dairy farmers to decrease the number of cows they feed (and the amount of total methane released to the atmosphere) but still produce the same amount of milk.

A second USDA-EPA program is AgSTAR, designed to promote the use of livestock manure as an energy resource. The waste management system used allows farmers to collect methane released by the waste as it decays anaerobically (in the absence of oxygen). The waste is collected in a covered digester lagoon. The methane can either be burned via a flare or used to run electrical generators. The electricity produced by a generator can be sold back to the electric company, and the heat from the generator can be used to heat buildings or to maintain the temperature of the digester lagoon and ensure that the waste is broken down. Once the methane is removed, the waste is used as fertilizer for fields. Such an operation not only saves farmers money for energy costs, but it also greatly reduces methane emissions to the atmosphere. Another significant benefit is that this application controls odors.

On the Internet:

For more information on methane, global warming, and EPA programs, see the following:

- **Methane (http://www.epa.gov/methane)**
- **Global warming (http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html)**
- **EPA programs (http://www.epa.gov/methane/voluntary.html)**